

Chapter 5 – Greenhouse Operations

5.1 Purpose

The purpose of this chapter is to identify and define the BMPs for greenhouse operations. King County greenhouses produce more than 35,000 plants annually. Any serious errors in managing the greenhouses could result in the loss of entire crops and the additional costs of replacing them.



5.2 Definitions

Greenhouse: house of glass, polycarbonate or fiberglass construction used for propagation, growth and care of plants.

5.3 Background

The King County Park System (in partnership with the departments of Construction and Facilities Management and Community and Human Services) operates and maintains a growing facility at the Cedar Hills Treatment Center, 15900 227th Southeast in Maple Valley, Washington. The growing facility has one warmhouse, one cold house, potting sheds and adjacent nursery areas.

The greenhouses and adjacent nursery are used to propagate and hold plants for introduction into park landscapes and other public areas. These plants are grown in large production crops with extreme care taken to ensure their high quality.

Staff grows and holds annuals and many flowering perennial plants in the Cedar Hills facility. As with propagation of woody plants, it is more cost effective to grow these plants in the larger sizes and in specific varieties needed than to purchase them retail. In-house propagation also provides significant flexibility in matching types and sizes of plant species to specific needs of various facilities.

5.4 Special Equipment

Climate Control Systems

- A computerized, programmable clock automates irrigation for the warm greenhouse, which is commonly known as a “warmhouse.”
- Thermostats automatically control heating, ventilation and cooling systems.

- A humidifier wall introduces humidity and cooling in the ventilation system of the warmhouse to aid in keeping the high humidity and temperature regulation that is required.
- Ventilation, heating, misting and lighting all help maintain diverse conditions for optimal crop production and holding capacity.
- Greenhouse irrigation and heating/ventilation are programmed depending on the conditions needed.
- The greenhouse staff plans to soon purchase GEM III (Greenhouse Environmental Manager) software.

Fertilizer Injector Systems

The warmhouse uses an automatic fertilizer injector system connected to a programmed irrigation clock. The cold house uses a manual irrigation system that also can be connected to the fertilizer injection system when needed.

Soil Sterilizer

Greenhouse staff uses an electronic soil sterilizer to heat soil to sufficient temperatures to kill soil microbes and diseases that could infect young plants.

5.5 Maintenance Practices

The following are routine practices for greenhouse maintenance and production.

Building Maintenance

- Perform routine maintenance and upkeep of all greenhouses, potting shed, future shade house, drainage and storage shed for safe day-to-day operations. Routine maintenance consists of tasks required to keep the structures clean and in good operating condition.
- Maintain all equipment in good working order. Equipment includes trucks, tractors and motorized carts used in or around the greenhouses.
- Keep tools and supplies well organized and properly stored. Supplies include flammables, pesticides and other toxic materials.
- Coordinate repairs and servicing with the appropriate crafts people to identify and direct annually scheduled preventive maintenance and repairs for the upkeep of the greenhouse and related structures, equipment and surrounding areas.
- Review emergency procedures for natural disasters, power outages, and structural stresses from wind and snowstorms. Make sure back-up generators are equipped with fuel and oil for 72 hours of continuous operation. Confirm that the emergency phone and pager numbers are readily available and link Cedar Hills' front desk staff to Parks on-call supervisors.

- Follow-up on irrigation winterization.
- Use heat tape to winterize interior water pipes for greenhouses and office. Make sure to have portable heaters and generator ready in case of power outage.
- Pressure wash and sterilize interior of glass house twice a year.

Production

Planning

It is important to secure client information early enough to accurately complete plant order requests. Gathering this information is often time-consuming. And it requires many hours to secure seeds, plugs and cuttings.

- Make a crop schedule calendar for one year. The calendar must show dates for producing, distributing, rotating plants, identifying growing table space needs and for purchasing stock and supplies.
- Accurate planning schedules must be maintained and reviewed by the Greenhouse Committee at their quarterly meeting.

Propagating, Growing and Transplanting

- Methods of propagation include, but are not limited to, seeds, cuttings, divisions, and plugs.
- Horticultural principles must be specific to diverse crops, non-native or native crops.
- Plants are potted and repotted to ensure sufficient space for root system growth and good general health. Both staff and volunteers participate in these efforts.

Plant Distribution

Currently, plants are picked up by the Regional Utility, District or location staff, and transported in open tarped or untarped trucks to locations where they are either planted or held for planting. Open-bed trucking often injures and damages plants.

We recommend that a specially equipped 18-foot-long box van with an 8-foot-long lift-gate be used. This truck would have adjustable storage racks and overhead hooks for transporting large flowering baskets. Large rolling racks are loaded with pots of plants and lifted into the truck for transport. Damage to plants is kept to a minimum and efficiency greatly improved through use of such a truck. Otherwise, plants should be tarped and transported at low speed.

5.6 Cultural Care

The following are guidelines for preventing problems that can occur in greenhouses production facilities.

- Routinely groom crops. Remove algae from floors with pressure washer. This routine grooming prevents slipping. It also cleans tables, sidewalls and pots to reduce disease potential.
- Thoroughly water plants as needed. Intermittently water with non-fertilized (clear) water to leach salt buildup in soil—usually every 6 to 7 days.
- Fertilize crops as needed with fertilizer appropriate for the crop.
- Fertilize with the existing fertilizer injection system every time watering is done unless the intent is to leach salt build up.
- Provide shade for plants that need shading.

5.7 IPM

Greenhouses are a production operation dealing with large numbers of plants in a closed environment. Because these crops are expensive, pest tolerance levels are much lower in a greenhouse environment than in a general park landscapes. In the greenhouse, careful monitoring is essential for documenting when diseases, insects and weeds are emerging.

Thresholds

The following BMPs eliminate damage to these plants and reduce the potential of introducing pests into the landscape:

- Weeds are not tolerated in either greenhouse.
- Insect pests that threaten the health of production crops are not tolerated in greenhouses.
- Diseases that threaten the health of crops are not tolerated.

Control Strategies

Weed Control

The following are management techniques for weed control in greenhouses:

- Hand weed greenhouse operating areas and containers to keep them free of weeds.
- Control weeds in exterior areas, building perimeters, shade house and related spaces either by hand or mechanically with push mowers and string trimmers or suppress them with landscape fabric.



- Strictly follow WSDA regulations and label instructions.
- Anyone applying a pesticide must have a current Washington State Public Operator's license. Apply pesticides only when necessary. See chapter 3, IPM.

Insect Control

Insects are routinely monitored by visual inspection, or through the use of “sticky traps.” Populations are kept below injury levels by:

- Using proper cultural practices including regular irrigation and fertilization.
- Removing insects by hand or wash them off affected parts of plants.
- Using the biological control of beneficial insects and other organisms that attack pest insects. Periodically release beneficial insects to help suppress and reduce the need for chemical control. Beneficial insects used as biological controls include Lady Bugs, Preying Mantis and *Bacillus thuringiensis*.
- Spot treating specific plant parts with the least toxic, yet effective insecticide such as Safer™ Soap.

Disease Control

Disease pathogens are controlled by the following methods:

- Provide good sanitation techniques. Regularly remove plant debris and keep tools and work areas clean.
- Provide proper spacing between plants for good air circulation.
- Select disease resistant plants from reputable vendors.
- Keep diseased plants away from healthy plants.
- Apply the least toxic, but effective pesticides to control a specific disease pathogen on a specific plant or crop. An example is Safer™ Soap

5.8 Training

Basic Greenhouse Training

Basic training must be thorough and practical, yet specific to location and type of work. Full-time greenhouse staff trains two groups:

- People inexperienced in greenhouse operations but expected to perform a wide range of skilled tasks. These workers must complete a reasonable period of hands-on experience and training. This group includes new employees, volunteers and clients assigned by Cedar Hills Treatment Center.
- Full-time staff in districts that operate greenhouses.

Advanced Skill Training

Employees are encouraged to pursue work-related training and to network with other field professionals to continue skill development. Parks should encourage and support staff to actively pursue and become involved in professional organizations.